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A COMPARISON OF THE ABILITY OF BOYS AND GIRLS IN
SECONDARY SCHOOL MATHEMATICS

by

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The question of inherent differences between men and women has long furnished opportunity for endless debate. It has been assumed that certain qualities belonged predominantly to the one sex or the other; but one by one these assumptions had to be abandoned as women gained more freedom, and developed more and more those characteristics which were supposed to be masculine. We must needs finally accept the conclusion that many of the so-called differences between men and women have been due to social conditions, opportunities and conventions, rather than to inborn tendencies. Whether or not this is true of all qualities of the human mind is still a question, one which only time can settle.

The present study is an attempt to make a comparison of the difference in sex ability in a very limited field, that of mathematics in the secondary school. Tradition claims that the girl has not the mental qualities necessary to enable her to make a success of the study of mathematics. There is an idea, quite prevalent among the pupils themselves, and even among older people, that mathematics has proved a serious stumbling block to the majority of high school girls. To determine whether or not this tradition has any foundation this comparative study of the ability of boys and girls in secondary school mathematics, chiefly algebra and geometry, has been undertaken. It has been found exceedingly difficult to determine just what constitutes real

mathematical ability and how much of what is usually termed mathematical ability is simply due to the general abilities of application, faithfulness, accuracy, etc. Since the results shown here are based entirely upon study of school-room work and hence upon school-room standards, it seems necessary to limit the expression, mathematical ability, to ability to accomplish the work prescribed in the mathematics courses of three schools, the Madison High School and Wisconsin High School, of Madison, Wisconsin, and the Lincoln High School, of Portland, Oregon.

Three lines of investigation were followed: (1) The opinion of a number of experienced teachers of mathematics in secondary schools was sought; (2) Such information as possible was gleaned from the observation of classes at work; (3) A comparison of the school ranking of boys and girls in mathematics and in other subjects has been made.

To twenty teachers, seven in the Madison High School, three in the Wisconsin High School, and ten in the Lincoln High School, the following question was put, "How does the work of the girls in your classes compare with that of the boys?" Their answers varied, probably some of them were tinged with prejudice. A few typical replies follow:

One young woman in the Madison High School thinks, "That the boys are quicker and brighter, but the girls can be depended upon to do the mechanical work. They will work harder, but I have some boys who work just as hard."

"Girls are more faithful, boys more original", says another instructor, a man. By faithful he said that he meant that they would follow instructions more carefully, doing exactly as they were told and that they could be depended upon to persevere in a piece of work until it was completed.

Another man said, "Girls are more faithful. Boys show a little more originality, probably because they are lazier and hence will seek new devices and answer quickly in order to escape the hard work". This answer is a mere supposition and consequently does not carry much weight.

One teacher who has taught in the Madison High School for a number of years gives an opinion almost the opposite of this one. She says, "Where mathematics is elective there are not as many girls as boys in the classes. The girls may not be quite as efficient as the boys, but they do as well or better in solving original exercises. They do not like the routine work of proving theorems. Girls are more faithful." This instructor claims that girls are not less, but probably more original than boys. Perhaps this may be accounted for by the fact that she herself is a woman and confessed that she finds great enjoyment in original work.

A man in the same school said, when the question was put to him, "There is no difference at all. The girls do just as well as the boys."

An instructor in the Wisconsin High School who has had a wide experience and is known to be an expert teacher, gives

the opinion that, "There is no difference at all between the work of boys and girls in mathematics, except that the girls will follow mechanical instructions more closely. They show just as much originality as do the boys, in solving an original exercise. It depends entirely upon the individual pupil."

A similar answer was given by the woman who is head of the mathematics department in the Lincoln High School, Portland, Oregon. She has taught for a great many years and declares that she can find absolutely no general difference between boys and girls, so far as their mathematical ability is concerned. The girls are inclined to be less ready with their answers, but she thinks this is due to fear of making a mistake, rather than to lack of knowledge.

In the same school another teacher of long experience says, "There is no difference in the real mathematical ability of boys and girls. The girls make a better showing in the high school because they are more mature and better able to grasp the intricacies of algebra and geometry." This statement was interesting as she was the only one who mentioned the question of maturity affecting the work of pupils during this secondary school period.

Out of the twenty answers received, ten held that girls were just as original and showed just as much ability in mathematics as the boys; six claimed that they were less original, while one placed the girls higher than boys in the

scale of originality. The other three did not mention this quality. Fifteen attributed to the girls a greater degree of faithfulness, or some similar quality. While this quality is of great assistance in the accomplishment of any task, it cannot, of course, be termed mathematical. These two attributes, originality and faithfulness, were the only ones mentioned by more than one or two of the instructors questioned. They did not dwell upon accuracy, upon ability to grasp an explanation, upon the amount of interest manifested, nor upon any of the other qualities which might be considered essential in a good student of mathematics. Perhaps the testimony of a few scattering teachers has little value, but it may be well to note that the majority of the twenty regarded girls as being as capable as the boys, even in original work, which after all is the only test of real mathematical ability which the school affords.

The second method of approach to this subject was through observation of a number of mathematics classes in each of the Madison high schools. In all, about forty observations were made of sixteen different classes, it being found necessary to visit each one at least twice, in order to form any kind of an estimate of the work, and even then, there were some cases in which no conclusion could be reached.

In the Madison High School, there were enrolled last year, 983 pupils, 736 of them, or 75%, in the mathematics classes. This would seem to insure a fairly typical selection of pupils. Classes in algebra, plane and solid geometry, were visited and an attempt made to compare the work of the boys with that of the girls.

Among the first classes to be observed was one in algebra where twelve girls and seven boys were working exercises in simultaneous equations. The first exercise was solved correctly in the time allotted by eight girls and two boys. At least three or four of the girls and perhaps two boys worked carefully, accurately and as if they understood what they were doing. The boys seemed on the whole to be less business-like about their work. They were inclined to gaze around the room, wasting time, while they waited for the instructor to tell them what to do next. There were also one or two girls who were apparently quite unable to solve the problem without assistance, but they seemed to be trying. On another visit to this same class, a short written lesson occupied the first part of the hour. One of the girls whose efficiency had attracted attention before, was the first to complete and hand in her paper. Later, when the examples were discussed, she gave evidence, not only of the ability to work out a particular exercise, but also of being able to analyze the processes and state them clearly. During this discussion the girls were more ready with their responses

than were the boys, and at least gave the appearance of being more interested. The majority of the boys seemed to be unresponsive and indifferent. This is not to be taken as a proof that they had less natural ability than the girls, or even that they were less capable of doing the work, but for some reason they were not particularly interested and did not make a favorable impression. When the grades for this class were obtained, it was found, as had been expected, that the girls were rated higher than the boys, their average being 83.9% as compared with 75.8%. Sixty-nine percent of the girls and only thirty-three percent of the boys had a grade of 80% or above. The highest average, 95%, belonged to a girl, but two of the boys who had been regarded during the observations as above the average, were graded 85% and 90%. These results show a very close agreement between the rating of the observer and that of the instructor. Since the grades were not obtained until after all observations had been made, and since the agreement found in this particular class was also found in a majority of the classes visited, it is believed that this method may not be altogether without advantages, although it is necessarily incomplete and probably tinged with personal prejudice.

In another algebra class it was decided after hearing two recitations that the boys were more interested and were doing the more efficient work. In this class there were fourteen boys and only half as many girls, a condition exactly the oppo-

site of that in the section described above. The girls were this time the indifferent ones. They did not respond readily to general questions put to the class, and although, when sent to the board, their work was fairly well done, it seemed to be mechanical. The grades confirmed the decision that one of the boys was the best pupil in the class, his standing being 96%. Three other boys were above 90%. In all, fifty-seven percent of the boys had averages above 80%, as compared with only forty-three percent of the girls.

In a class in plane geometry, work of an interesting character was in progress. Several problems in construction had been assigned for the day, each one to a group of two or three pupils. These groups had talked over their respective assignments and planned which member should put the construction on the board, which explain it, and which prove that it was correct. The recitation was very successful, although it did not move with the mechanical smoothness so often seen in the class-room. The girls seemed to be especially interested and eager for their particular group to be called upon. They were quick in answering questions and watched closely for errors in the work of others, which they might correct. Several suggestions of shorter or better methods of solving a problem were made in the course of the period. The boys, however, did not appear to be enthusiastic. Evidently the game spirit which had developed among the girls did not appeal to them. Perhaps this particular kind of a game was too tame and had too

little reward; or perhaps they were discouraged by being in the minority, since they were outnumbered three to one. Only one boy gave a good recitation. He showed unusual ability to reason out a difficult situation, but as he had misunderstood the problem, his work was incorrect. Later, when the grades of this class for the term were obtained, it was found that the girls had an average 10% higher than that of the boys; two of them had standings of 94%, three others 93%. The boys made a very poor showing, only one, the boy mentioned above, was graded above 90%, one other above 80%, while two of the six had failed.

The greater part of the recitation of another geometry class was spent in making a list of equations, which could be constructed. The pupils had already constructed them, but when called on for the completed list, they seemed to be entirely at a loss, and it was only after a long and painful effort that they were finally able to gather together the various cases. With the one or two exceptions, neither boys nor girls seemed to be very wide awake; one little girl was always ready with an answer and a boy, probably a year or two older than the majority of the pupils, seemed to be relied upon by both teacher and class to keep the recitation from being an absolute failure. The general average of the 14 girls was ascertained to be 80.1%, that of the 8 boys 77.5%. The little girl who attracted particular attention led the class with a grade of 98% and forty percent of the girls

ranked above 80%, as compared with twenty-five percent of the boys.

The observer's estimate of another class did not agree as closely with that of the instructor. Some exercises and theorems in plane geometry formed the subject matter of the lesson. The girls as a whole did not appear to have grasped the lesson at all; not one of several who were called upon during the early part of the hour, could give a logical proof. The boys showed they were thinking, and although they did not always recite perfectly, they were able to recall quickly the theorems and corollaries which were needed in the work. Toward the end of the period, one girl gave a clear-cut, well-rounded recitation, giving evidence, not of the ability to repeat mere words, but of good sound reasoning. Her average, 94%, was the highest in the class, as was expected. It was a decided surprise however, to discover that the general average of the girls was higher than that of the boys. Upon closer examination this was found to be due to two failures among the boys, of whom there were ten percent more ranking above 80% than there were of the girls.

One other class in plane geometry was observed. Each of the pupils had cut a six-sided polygon out of paper, and after marking the angles, had cut them off. The first part of the period was spent in fitting these together in such a way as to show that the sum of the angles was equal to four straight angles. A polygon of five sides was then tried and

the class finally developed the general statement for the sum of the interior angles of any polygon. The exercise was extremely interesting and at first no difference in the relative ability of the boys and girls was to be found. If anything, the boys seemed to be doing a little more actual thinking and it was a boy who gave the statement of the general formula. The mechanical part of the work, together with the concrete evidence which it furnished, was apparently more interesting to them. When asked, the instructor said that he could see very little difference between boys and girls, but the averages showed the boys to have a grade about 4.3% higher than that of the girls.

There were two kinds of solid geometry classes in the Madison High School, owing to the fact that it had recently been dropped from the list of required subjects. The classes for third year pupils were entirely elective; those for the fourth year required of all pupils. In one of the elective classes there were four girls and ten boys. During two recitations only one of the girls gave any sign of being interested or caring to do the work. They seemed occupied with matters not pertaining to geometry and hence were not paying attention. The boys, although restless and hard to control, were wide-awake, ready with their answers and showed that they understood what they were doing. While not strictly mathematical abilities, interest and attention are certainly essential, if the pupil is to obtain or give any information of a

mathematical character, and consequently they are mentioned frequently in the record of these observations. The boys in the class seemed to be typical of those observed in other classes. The girls also appeared to be typical, although all but one were really below average. The class as a whole did not seem to have the motive or interest in their work which is most likely to be found in a class of pupils who have elected the subject. The averages, 83.3% and 81.3% of the boys and girls respectively, did not show as much difference as the class observations had pointed to, but this was partly due to the fact that one of the four girls had a grade above 90%.

The fourth year classes in solid geometry were much larger and had a larger proportion of girls. In one division, there were seventeen girls and nine boys, but although two visits were made, no definite conclusions could be drawn as to the efficiency of individual members of the class. The teacher's report showed a higher grade for the boys, seventy-five percent of whom ranked above 80%. Only thirty-nine percent of the girls had reached as high a standing.

This method of studying the relative ability of boys and girls is not accurate, nor can it do more than suggest that which we may look for in further research. If the estimate of the observer did not agree in most cases with that of the instructor, the method would have still less value. Since they

do tally very closely, enough value is attached to the observations to make it seem permissible for them to be used. In the case of six of the eleven classes visited in this school, the conclusion of the visitor was found to agree with the school records; in four classes no decision was reached. The following table gives the results of the term's work for the classes visited as entered on the final reports.

SUBJECT	BASIS	AVERAGE GRADE	PERCENTAGE ABOVE 80%	HIGHEST GRADE	LOWEST GRADE	FAILURES
Algebra	6 Boys	75.8%	33	90%	70%	0
	13 Girls	83.9%	69	95%	70%	0
Algebra	14 Boys	83.2%	57	96%	70%	0
	7 Girls	78%	43	84%	68%	1
Algebra	8 Boys	76.6%	62	95%	61%	2
	16 Girls	80.2%	62	90%	64%	2
Plane Geometry	14 Boys	77.5%	29	94%	69%	0
	10 Girls	80.1%	40	98%	69%	0
Plane Geometry	8 Boys	71.8%	37	90%	38%	2
	15 Girls	77.8%	27	94%	71%	0
Plane Geometry	11 Boys	82.9%	63	91%	69%	0
	12 Girls	78.5%	50	89%	69%	0
Plane Geometry	6 Boys	73.6%	17	90%	50%	2
	17 Girls	83.5%	65	94%	73%	0
Plane Geometry	11 Boys	78.3%	27	92%	71%	0
	14 Girls	83.5%	57	94%	72%	0
Solid Geometry	12 Boys	83.3%	67	94%	71%	0
	4 Girls	81.3%	53	90%	75%	0
Solid Geometry	8 Boys	83%	50	94%	73%	0
	14 Girls	82%	57	95%	73%	0
Solid Geometry	8 Boys	83.2%	75	94%	79%	0
	18 Girls	81.1%	39	94%	71%	0

If the grades of pupils in all of the thirty-three

classes in algebra and geometry are used, the following averages result:

SUBJECT	BASIS	AVERAGE GRADE
Algebra 13 Classes	128 Boys 151 Girls	79.39% 80.97%
Plane Geometry 11 Classes	101 Boys 151 Girls	77.2 % 80.59%
Solid Geometry 9 Classes	101 Boys 93 Girls	81.92% 79.41%

Both from these figures and from those of the preceding table, it is apparent that according to a school-room ranking, the girls did work of a slightly higher grade than did the boys in algebra and plane geometry, while in solid geometry they fell about 2.5% below the boys. It cannot be determined and should not even be assumed, without further evidence, that this is usually the case.

The question of whether or not we are dealing here with typical pupils is one which cannot be easily decided; but since this work, with the exception of two classes in solid geometry, was required of all pupils, and since the school is fairly typical of the American public high school, it is probable that these boys and girls were representative of the type. In the two solid geometry classes mentioned, there were but five girls to compare with twenty-eight boys. During the visits made to these classes, they did not compare favorably; but their average grade was exactly the same as that of the other 88 girls taking solid geometry. The general aver-

age of the boys in these elective classes lacked only one-tenth of one percent of being the same as that of the boys in other solid geometry classes. If then, these were atypical pupils, the difference does not appear at least in their grades.

Other interesting facts attract our attention in the study of these records. For thirty-three classes seven percent of all the boys and six percent of the girls stood at the head of their classes; ten percent of the boys and eight percent of the girls had grades lower than any of the other members of their sections; six percent of the boys and five percent of the girls failed to reach the passing grade, 70%. These results show surprisingly little difference between boys and girls in so far as either marked superiority or inferiority is concerned. The boys have one percent more at the head and one percent more at the foot of the class; they seem to have varied a little farther from the mean.

Having compared the standings of the boys with those of the girls in the different branches of secondary school mathematics, it was thought that it might be advantageous to compare their work in mathematics with that in other subjects in the curriculum. In order to do this, the complete reports for pupils in the second, third and fourth years, were used, (it was impossible at the time to obtain the year's records

ALGEBRA

BASIS: 251 BOYS 359 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

100%
0%

GEOMETRY

BASIS: 152 BOYS 177 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

100%
0%

SCIENCES

BASIS: 170 BOYS 227 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

ENGLISH

BASIS: 251 BOYS 359 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

100%
0%

LANGUAGES

BASIS: 126 BOYS 213 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

100%
0%

HISTORY

BASIS: 158 BOYS 182 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

Diagrams showing the percent of pupils having averages of, from 90-100%, 80-90%, 70-80%, and less than 70%; for the year 1912-1913, Madison High School, Madison Wisconsin.

for first year pupils). In the accompanying diagram the results of this comparison are given. The number of pupils whose grades were used as a basis for the percentages is given at the top of each diagram; on the right hand is a scale representing 100 units, from which the percent of boys or girls having grades falling within any one of the four groups chosen, 90-100%, 80-90%, 70-80% and below 70%, can easily be seen. Before looking more closely at these diagrams, let it be noted how few failures have been recorded in any subject. This can be explained by the fact that the failures have usually been made up, and in these cases, only the final grade is given on the record cards.

Examining the diagrams more in detail we find that in algebra fourteen percent of the boys had grades above 90%, while thirteen percent of the girls were above 90%, sixty-four percent above 80%. In other words, sixty-four percent of both boys and girls were graded 80% or above. In geometry the percentages of boys and girls, respectively, who ranked above 90% were seventeen and sixteen; sixty-one percent of the former and forty-five percent of the latter ranked above 80%. In algebra the boys and girls were practically on an equality; in geometry the superiority of the boys is more pronounced, although a slightly greater percent of them failed to make 70%. If we consider all of the sciences offered in the school as a single group, we may discover from

the diagram almost no difference between the grades of boys and girls. In English the percent of boys graded above 90% is only one percent lower than that of the girls; but the percentage above 80% varies almost as much as it did in geometry, this time the girls being in the lead. In foreign languages they again excel, while in history the boys have much the greater percent above 80%, although not quite so large a number had exceptionally good grades, that is, between 90 and 100%.

These diagrams serve to show that there was a closer agreement between the grades of boys and girls in algebra than in any other subject, except those of a scientific character. It also makes clear the fact that a greater percentage of both boys and girls did good work in algebra and geometry than in any other subject. Sixty-four percent of the girls have averages above 80% in algebra, only fifty-five percent ranked as high in English, forty-four percent in history, forty-five percent in geometry, sixty percent in science and in only one subject a greater percentage, sixty-nine in foreign languages. The boys show a similar superiority in algebra, sixty-three percent of them ranking above 80%, but they also have sixty-one percent above in geometry, while the other subjects fall behind, fifty-seven percent in foreign languages, thirty-four percent in history, fifty-three percent in sciences and forty-one percent in English,

Thus, the boys made their poorest showing in English, the girls in history; both excelled in algebra, even when compared with their own work in other branches, while the boys also excelled in geometry.

Here we will leave the Madison High School and consider the results of a similar investigation of the Wisconsin High School, a much smaller institution with only seven classes in mathematics. This school is not typical as it is a private institution operated on a tuition basis by the University of Wisconsin. Probably the majority of the pupils are preparing for college, which fact does, of course, influence their choice of subjects. However, as the same influences will naturally affect both boys and girls, and as our work is one of comparison of the sexes, not of comparison of schools, the study of this school seems justified.

One of the five classes visited was a class in arithmetic and as this is not usually a secondary school subject, it will be omitted from our consideration.

The algebra class was divided into two sections, one being composed of those who showed ability to advance rapidly with the work, the other of those who were slow, or who for one cause or another had failed. The advanced division was visited on two or three occasions when the lessons were on simultaneous equations. Both boys and girls were doing

good work, but while passing around the room and watching the individual pupils solving the equations, and then representing them by graphs, the conclusion was reached that at least two of the girls and six boys were above the average, while one or two boys were not as capable as the rest and needed constant assistance. The seven or eight good pupils worked independently and seemed to understand what they were doing. When asked to put work on the blackboard and explain, they did so in a clear, concise manner, which signified an unusual grasp of the subject. Some of the other pupils could do the work when they were given a set form to follow, but they did not comprehend the meaning well enough to put it into their own words. The quickest pupil in the whole class and to all appearances, the most talented, was a little Russian boy. As in the case of classes visited at the Madison High School the observer's estimate was later compared with that of the instructor. The system of grading in this school is not on a percentage basis, but is one in which the letters E, G, F, P, and N are used to denote the varying degrees of achievement, from the highest to the lowest, or failure. In the class just described thirty-three percent of the boys and fifty percent of the girls had marks of E. Fifteen percent of the boys were graded F, the lowest grade given. This shows a greater percentage of girls having excellent standings than the work seen on

the days of observation would have seemed to warrant.

The other algebra class was of course not so good as this one, but some of the pupils were making notable progress. Almost all of the advance work was done during the class period so that there was an unusual opportunity to judge of the relative ability of pupils. Three of the seven boys, and two of the eight girls required continual oversight; they could take perhaps one step in a solution and would then stand helplessly, waiting for the instructor to assist them to the next one. The rest of the pupils worked with differing measures of success. They were allowed to proceed as rapidly as they were able and a good deal of interest had been thus aroused. One little boy who had been exceedingly lazy and careless was now working with surprising zeal, so anxious was he to surpass the other members of the class; the spirit of rivalry possessed him. Although no home work was assigned, most of the pupils came each day with a comparatively long list of problems ready for correction. On the whole the girls seemed to be doing the more efficient work; many of them seemed able to go ahead for themselves and apply a general rule to different exercises. This inference was borne out by the school records, as sixty-two percent of the girls as compared with twenty-nine percent of the boys had a grade of G, while twenty-nine percent of the boys and twenty-five percent of the girls made a mere passing grade.

of P. There were no failures.

A class in plane geometry was observed on a number of occasions, so that there was opportunity to witness work in both theorems and original exercises. So far as could be noticed the girls did as well in the original work as did the boys. On several occasions one or more of them came to class with a greater number of the exercises correctly proved, and this was especially noticeable on occasions when the solution was difficult. Every one of the five girls did good work, although one of them showed marked ability in reasoning out a complicated proof which no one else had been able to handle. The boys, of whom there were nine, were not very uniform either in attitude or work. Three or four of them were excellent, did good sound thinking, studied their lessons and were able to make a good showing both in the mechanical performance of work and in originality of thought. Several others seemed disinclined to do any serious thinking. In looking over the note books, those of the girls were found to be much neater and to comply more closely with the specified form. These virtues of course are not mathematical but general; however the girls also showed their ability to think, in their written work. The boys were more careless, not only in the points just mentioned, but also in putting in the details which make a well-rounded, logical proof. Thirty percent of the

boys and sixteen percent of the girls were graded E, but the general average of the girls was higher than that of the boys.

Only one other class was visited and as there were no girls present a comparison could not be made.

A summary of the information obtained from the five classes in algebra and geometry is given herewith.

SUBJECT	BASIS	PERCENT RECEIVING HIGHEST GRADE	PERCENT RECEIVING LOWEST GRADE
Algebra	7 Boys 8 Girls	29% G 62% G	29% P 25% P
Algebra	13 Boys 5 Girls	38% E 60% E	15% F 0
Plane Geometry	10 Boys 6 Girls	30% E 16% E	20% N 0
Plane Geometry	12 Boys 2 Girls	33% G 50% G	33% N 0
Solid	5 Boys 0 Girls	80% G	20% P

Taking all the classes together we find 18% of all pupils graded E, of which percent two thirds were boys and one third girls, but when we consider that the number of boys in the classes was more than double that of the girls, it is evident that a high standing was given to a larger proportion of the girls than of the boys. Nine percent of the pupils in these five classes fell short of a passing grade, all of them being boys.

It is interesting to note that in spite of the fact that arithmetic is the only mathematical subject required for graduation, that 62% of the girls were taking mathematics as compared with 66% of the boys. This fact is probably explained by the fact that most of the pupils are preparing for college and must have algebra and geometry to meet the entrance requirements.

The practise in the Wisconsin High School of marking pupils on their industry, initiative, attention, attitude and improvement, gives an opportunity not usually afforded, of comparing these qualities. The only difficulty lies in the fact that last year was the first year that such a system had been used and with only about 53 boys and 28 girls in the mathematics classes, the results are too limited to be of much value. They are given here, however, for what interest they may have. These rather intangible qualities are

graded A, high, B, medium, and C, low.

QUALITIES	BASIS	PERCENT GRADED		PERCENT GRADED C
		A	B	
Industry	53 Boys	42	33	25
	28 Girls	53	29	18
Initiative	53 Boys	30	49	21
	28 Girls	39	43	18
Attention	53 Boys	65	23	12
	28 Girls	71	25	4
Attitude	53 Boys	58	28	14
	28 Girls	61	28	11
Improve- ment	53 Boys	33	46	21
	28 Girls	36	43	21

ALGEBRA

BASIS: 20 BOYS 13 GIRLS	
BOYS	GIRLS
E	E
G	G
F	F
P	P

100%

0%

GEOMETRY

BASIS: 27 BOYS 8 GIRLS	
BOYS	GIRLS
E	E
G	G
F	
P	F
N	P

100%

0%

SCIENCES

BASIS: 48 BOYS 21 GIRLS	
BOYS	GIRLS
E	E
G	
F	F
P	P
N	N

ENGLISH

BASIS: 63 BOYS 40 GIRLS	
BOYS	GIRLS
E	E
G	G
F	F
P	P
N	N

100%

0%

LANGUAGES

BASIS: 66 BOYS 40 GIRLS	
BOYS	GIRLS
E	E
G	
F	G
P	F
N	N

100%

0%

HISTORY

BASIS: 44 BOYS 24 GIRLS	
BOYS	GIRLS
E	E
G	
F	
P	F
N	N

Diagrams showing the percent of pupils having grades of E, G, F, P and N, respectively; for the year 1912-1913, Wisconsin High School, Madison, Wisconsin.

Not only does the above table show that the girls stood higher than the boys in all of these qualities, but the difference is even more marked in the case of initiative than in attention, or attitude, both of which qualities have more often been attributed to women.

The study of the Wisconsin High School is concluded with a series of diagrams showing the relative achievement of boys and girls in algebra, geometry, science, English, foreign languages and history. These diagrams show that there is a greater percentage of girls than of boys graded G or above, in all subjects except science, although the boys have a slightly greater percentage graded E in algebra, science and history. Mathematics was the only subject in which there were no failures among the girls. Of course the small number of girls enrolled in algebra and geometry classes makes the comparison of doubtful value except when considered in connection with the results in other schools.

As no classes were observed in the Lincoln High School, Portland, Oregon, the investigation there consisted entirely in a comparison of the grades obtained from the school records for last year. Grades for all pupils taking mathematics were used in compiling tables. For convenience and greater clarity these results are given in diagrammatic form, corresponding to the diagrams showing the final re-

ALGEBRA

BASIS: 180 BOYS 171 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%
-70%	-70%

100%
0%

GEOMETRY

BASIS: 65 BOYS 52 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%
-70%	-70%

100%
0%

SCIENCES

BASIS: 117 BOYS 95 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%

ENGLISH

BASIS: 321 BOYS 287 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%
-70%	-70%

100%
0%

LANGUAGES

BASIS: 174 BOYS 90 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	80-90%
-70%	-70%

100%
0%

HISTORY

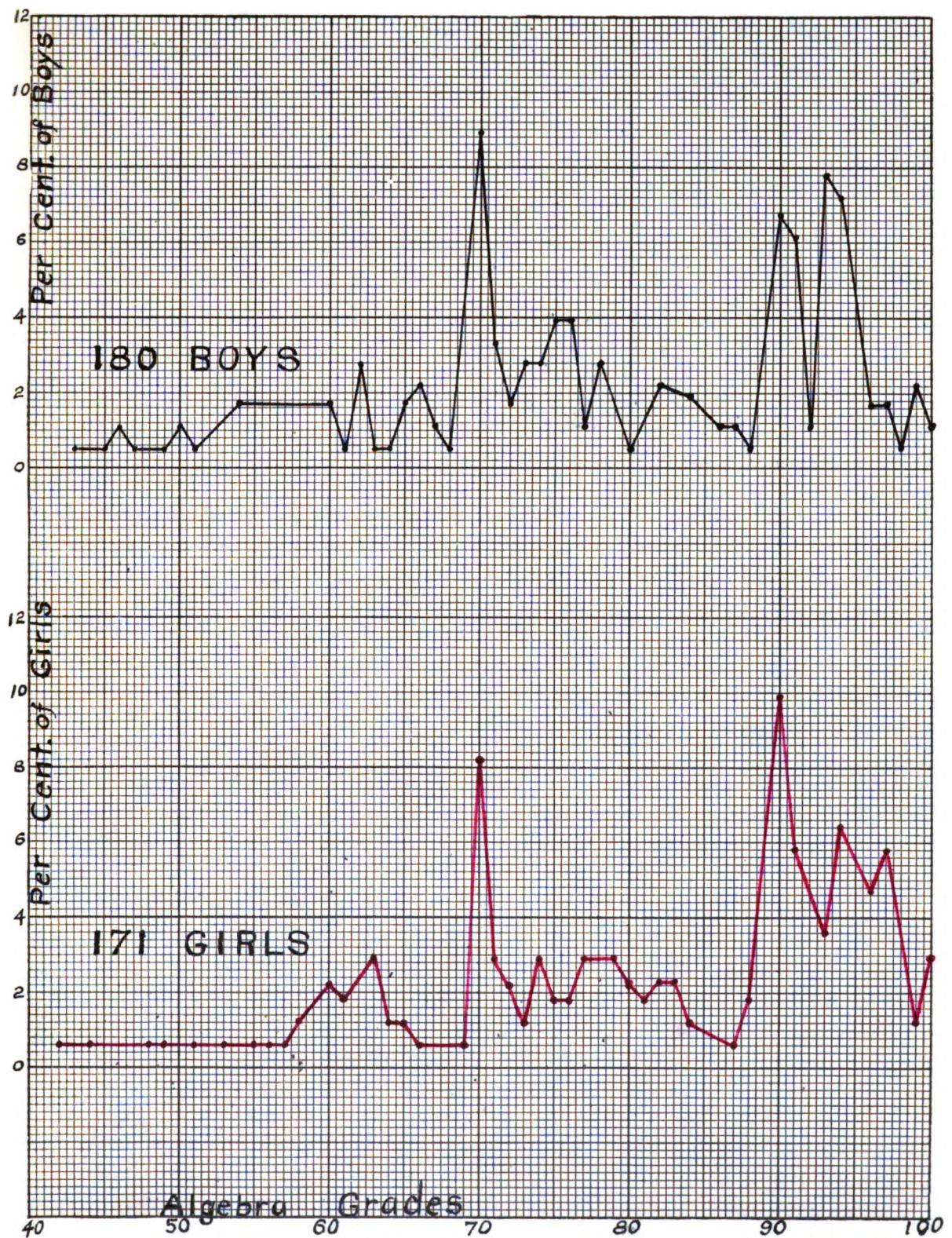
BASIS: 129 BOYS 95 GIRLS	
BOYS	GIRLS
90-100%	90-100%
80-90%	80-90%
70-80%	70-80%
-70%	-70%

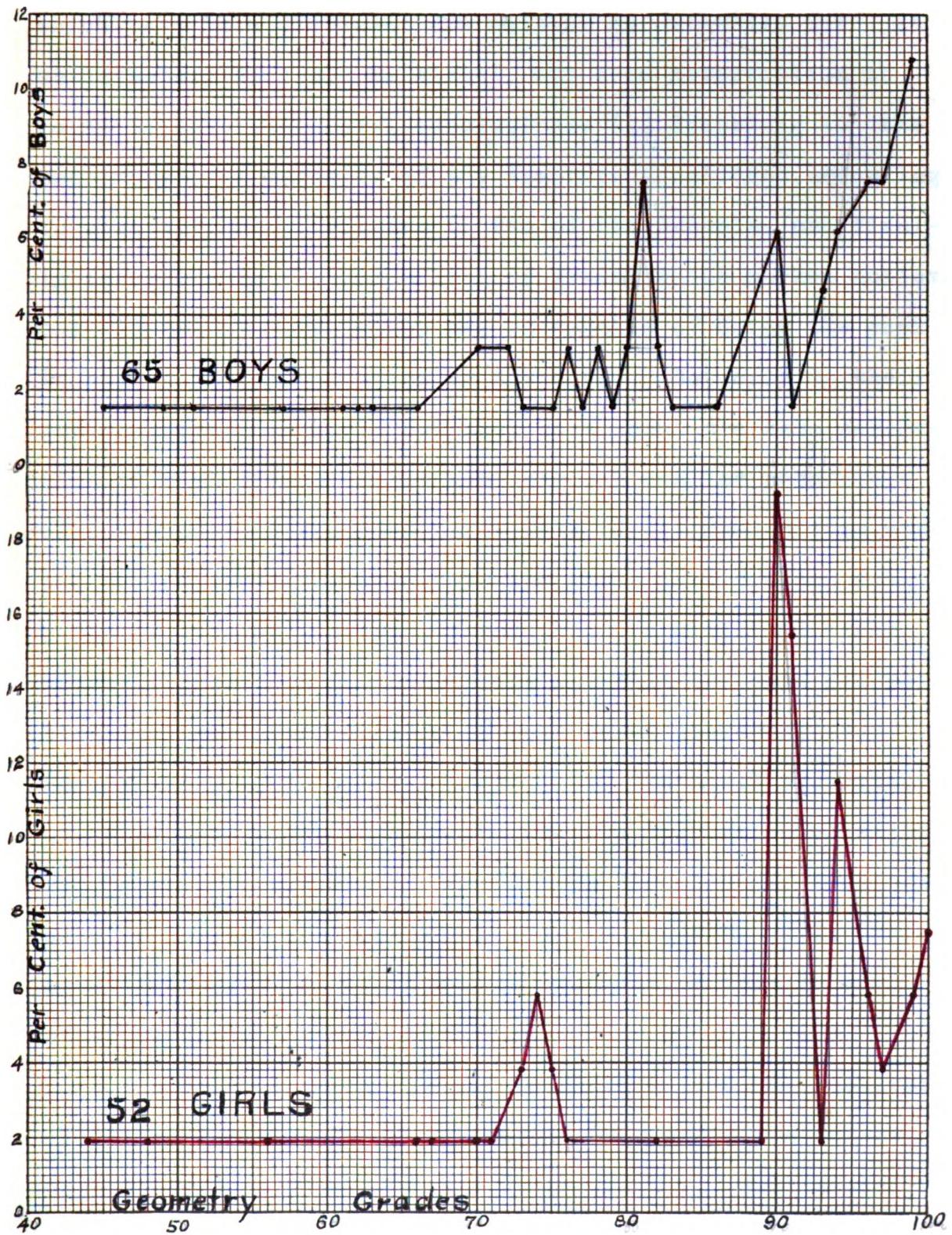
Diagrams showing the percent of pupils having averages of, from 90-100%, 80-90%, 70-80%, and less than 70%; for the year 1912-1913, Lincoln High School, Portland Oregon.

sults of the studies in the Madison and Wisconsin High School. One hundred and eighty boys and one hundred and seventy-one girls were taking algebra last year. It will be seen in the diagram that forty percent of the girls and thirty-six percent of the boys had grades above 90%, twelve percent of the former and eleven percent of the latter were graded 80% to 90%. In the geometry classes, both plane and solid, there were enrolled fifty-two girls and sixty-five boys. Of the girls sixty-eight percent stood above 90% in the final averages, four percent above 80%. The boys show a smaller proportion, fifty-four percent above 90% and seventeen percent above 80%. This means that according to the estimate of the teachers, the girls did better work than the boys in both algebra and geometry, if we consider plane and solid geometry together. In solid geometry they did not do so well, as only fifty percent of them were above 90% as compared with fifty-three percent of the boys. This latter comparison amounts to very little as there were but eight girls taking solid geometry. It does, however, bear out the results in the Madison High School where it was found that the girls did not stand as high as the boys in this branch of the mathematics work. In all other subjects the girls show a greater percentage above 90%, and also above 80%, except in history where the percents are the same. In English they have exactly the same percent, forty, above

90% as they had in algebra, but this is much smaller than the percentage of girls above 90% in geometry. Although the girls do not seem to have done as well in algebra as in science, foreign languages and history, they have a greater percentage of good grades in geometry than in any of these subjects.

On the following pages are curves representing the percent of pupils receiving each grade which was given in the classes in algebra and geometry in the Lincoln High School. The percents are based upon grades for the same number of pupils as were those in the diagrams, that is, one hundred and eighty boys and one hundred and seventy-one girls in algebra, sixty-five boys and fifty-two girls in geometry. It will be noticed that for each subject the curves for boys and girls are very similar. In algebra both rise abruptly at 70%, the grade of passing, and again at 90%. This latter increase in the number receiving a grade is due to the fact that all those making 90% or over are exempt from examinations. The graphs show as did the diagrams, that in algebra the girls have a slightly greater percentage of high grades, but the striking thing is that the curves are so nearly alike, the plateaus falling within almost exactly the same limits. In geometry also, we find the same marked similarity, with the greatest proportion again falling between 90 and 100%.





The results of the study of grades in the three schools which have been discussed are neither as extensive nor as satisfactory as could be wished, but seem nevertheless to point to several general conclusions: (1) According to the testimony of a majority of the teachers questioned, according to observations of classes in two of the schools, and finally according to the comparison of grades which marked achievement in school work, girls are as capable of doing the work in high school mathematics as are boys. Not only do their grades average as well, but they have about the same percentage of high grades and in most cases a smaller percentage of low grades. (2) From the three sets of diagrams giving comparisons of the grades of boys and girls in different subjects, it has neither been found that the girls did exceptionally poor work in mathematics nor that the boys did particularly well, the ability of both sexes averaging about the same in this as in other studies. (3) The small proportion of girls who failed in mathematics, the highest being eighteen percent in algebra in the Lincoln High School, does not seem to warrant the assertion, often made, that girls are more distressed over failures in mathematics than in any other subject.

Two other suggestions may be gleaned from our results: (1) There seems to be an indication that girls are not as capable as boys when it comes to the work in solid geometry.

Their inferiority, while not marked, was found in all the cases cited. (2) Girls are not lacking in initiative or originality, if we may trust the only actual grading of these qualities which was discovered, that of the Wisconsin High School, and also the opinions of eleven out of twenty teachers of mathematics who claimed that girls show just as much ability to do original work as do boys.

The results of this study are far too limited to admit of the conclusions being taken as proof of any fact regarding the ability of secondary school boys and girls. It is even a question as to whether the estimate of teachers as shown by a system of grading is really an estimate of mathematical ability or whether other qualities are allowed to hide what honestly might be termed mathematical. Since however, the term mathematical ability was limited in the first place to ability to do a certain kind of required work in algebra and geometry, we may fairly conclude that in the three schools studied, which are of different character and in two widely separated sections of the country, we have as much evidence of mathematical ability among girls as among boys.

Approval,
M. L. O'Shea,
9 June, 1914.

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